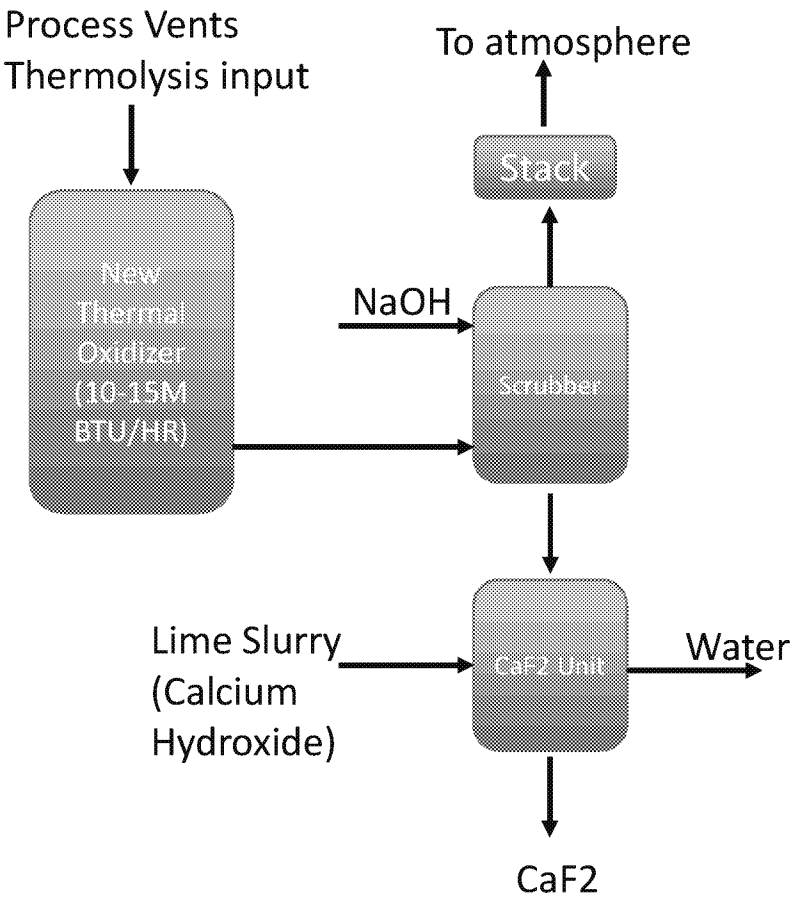
Technical Elements – Air Emissions Abatement Plan for Fayetteville Works

April 27, 2018

Thermal Oxidizer

Thermal Oxidizer

- Proven technology to capture and dispose of process vent streams and other non-aqueous process streams.
- Inputs are mixed with oxygen at high temperatures to oxidize the C3 dimer acid and other constituents.
- Process Vents include inputs from the following process areas: HFPO, VE-N, VE-S, RSU, MMF, TFE/CO2 and Polymers (Resins).
- Anticipated > 99.9% destruction capability.
- Project is being executed on an expedited schedule, and is expected to be in operation by April 30, 2020 (Subject to obtaining necessary permits).



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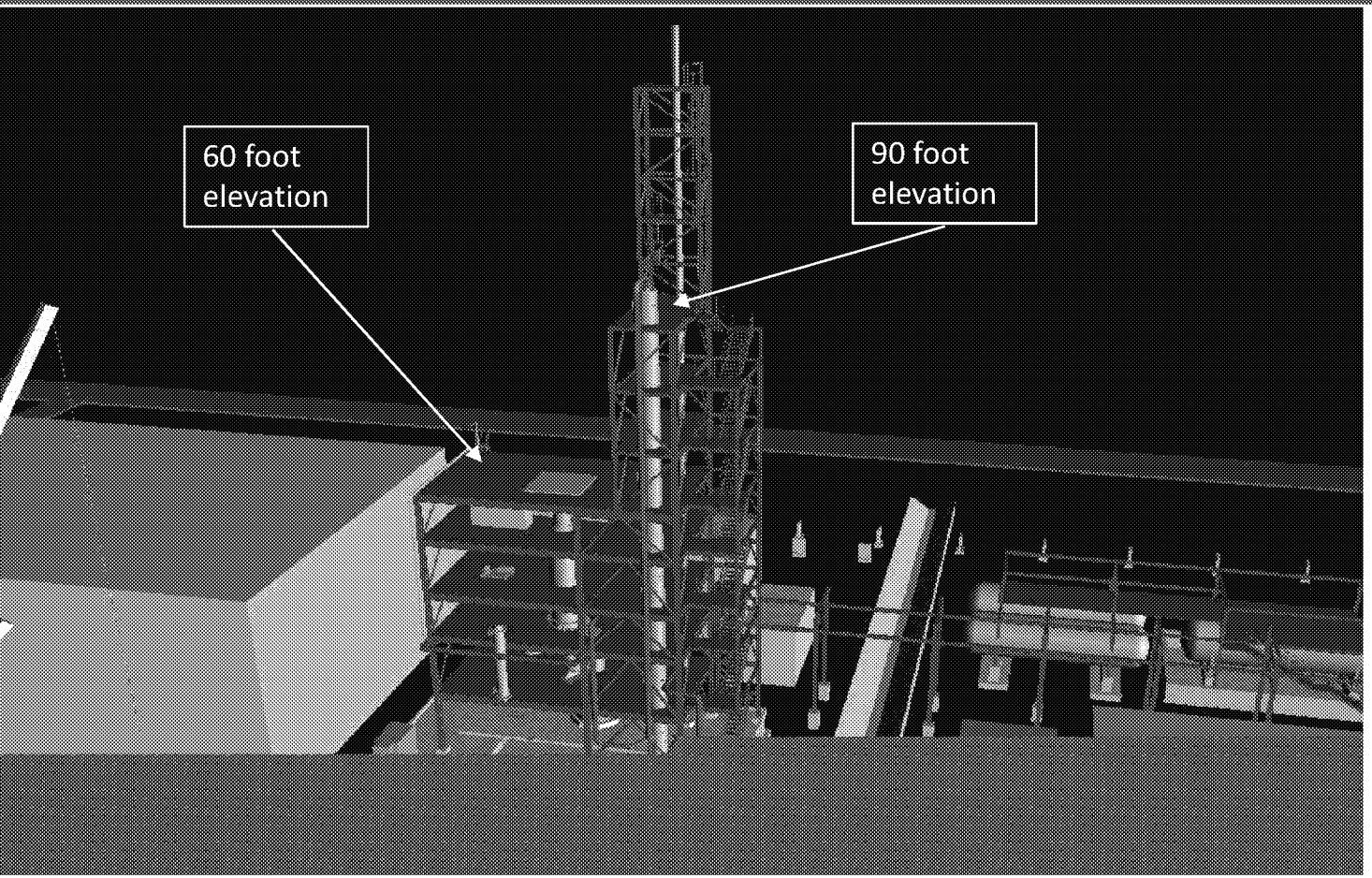
Thermal Oxidizer / Scrubber / Stack



The Thermal Oxidizer sits in a 5 story high structure adjacent to a 8 story high scrubbing system. In the background is the 150 foot stack for CO2 and water vapor emissions

Thermal Oxidizer Building

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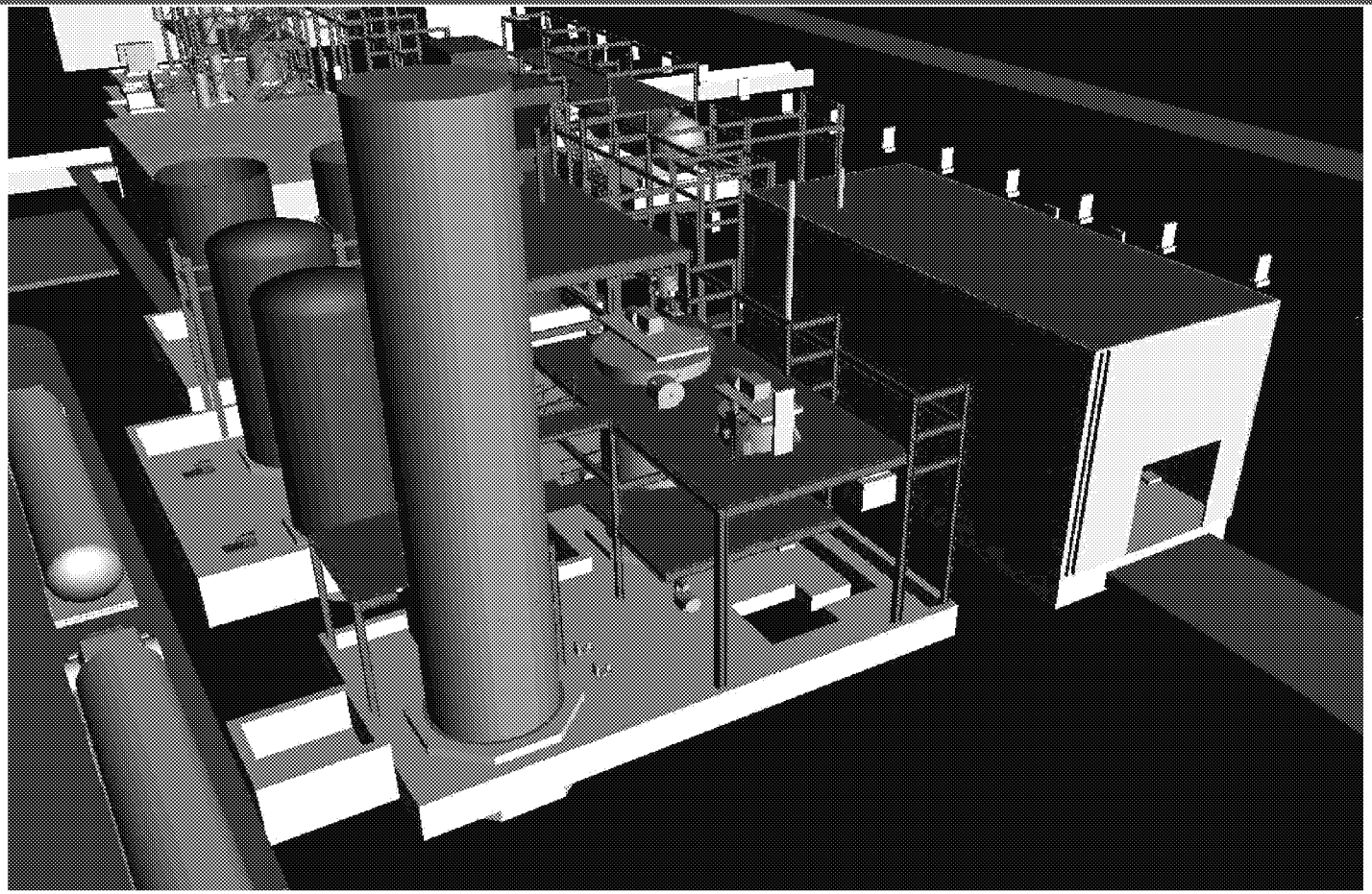
CaF2 System



Pebble lime will be stored in a silo, added to water to make a lime slurry, then added to the crystallizer with the thermal oxidizer outlet acid to form calcium fluoride in water. The calcium fluoride is removed as a solid in the filter press building

Lime Silo & Filter Press Building

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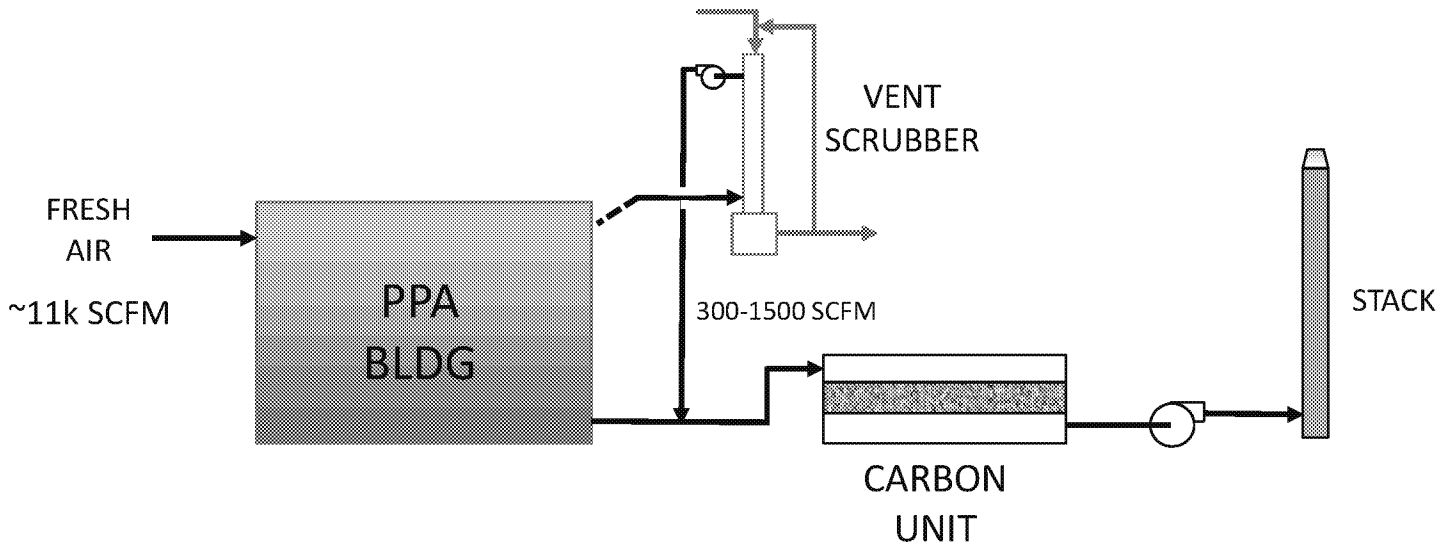
Carbon Bed: PPA

Granular Activated Carbon (GAC) dry system technology for the PPA indoor equipment and PPA scrubber discharge. The System is expected to be in operation by 5/25/2018, and has a target removal efficiency of 97%. Efficiency testing will be conducted to confirm performance and determine if any additional process changes are necessary to reach overall abatement goals.



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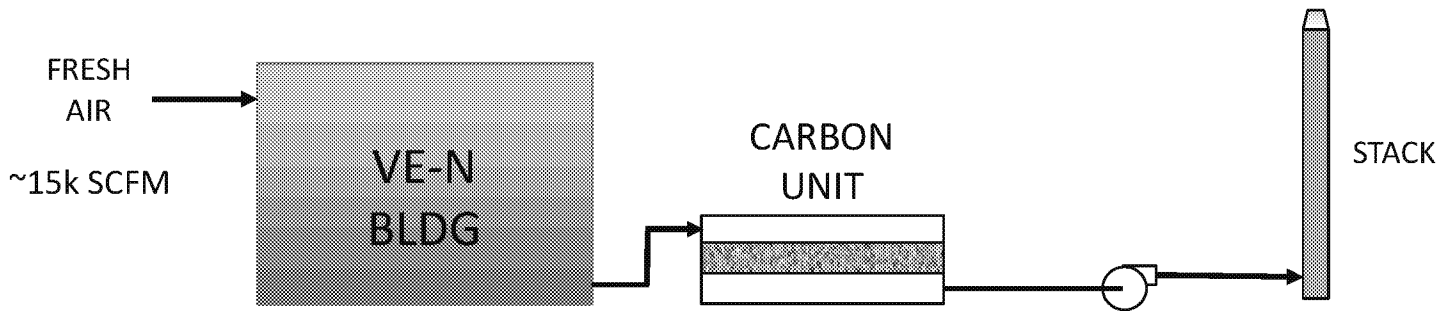
Carbon Bed: VE-N

Granular Activated Carbon (GAC) dry system technology for the VE-North indoor equipment. The system is expected to be in operation by 5/25/2018, and the target efficiency is > 90%. Efficiency testing will be conducted to confirm performance and determine if any additional process changes are necessary to reach overall abatement goals.



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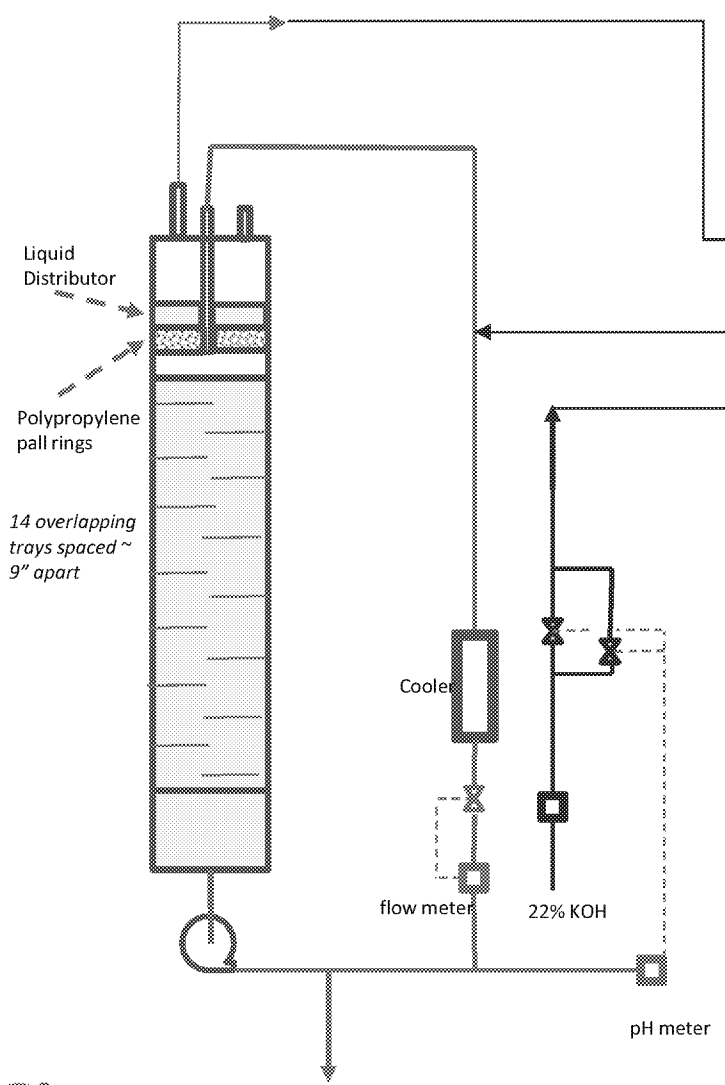
Division Waste Gas Scrubber Upgrade



Add 2nd Stage of scrubbing

Feed KOH to external tank through which vapor exit is bubbled –or- through a second packed bed.

Division WGS efficiency testing will provide information necessary to fully develop the preliminary design. Once preliminary design is complete, the efficiency improvement can be better predicted.

Expected implementation is October 2018.

Expected improvement is 40-80%.

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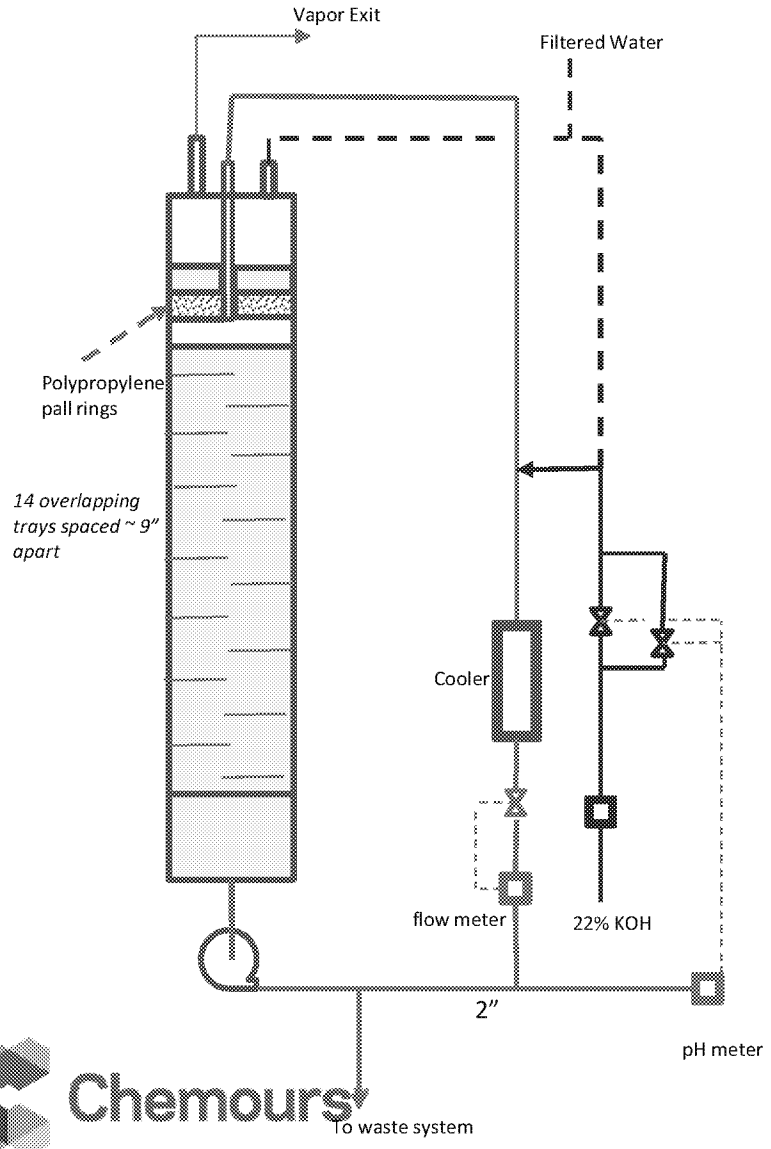
Division Waste Gas Scrubber Upgrade



Efficiency improvement test

Feed KOH to top of column over packed section (red dashed lines) instead of through the dip tube.

Change is a simple piping reconfiguration that can be executed quickly. It is expected that the short packed section will not provide significant improvement (not a sufficient depth to provide effective mass transfer).

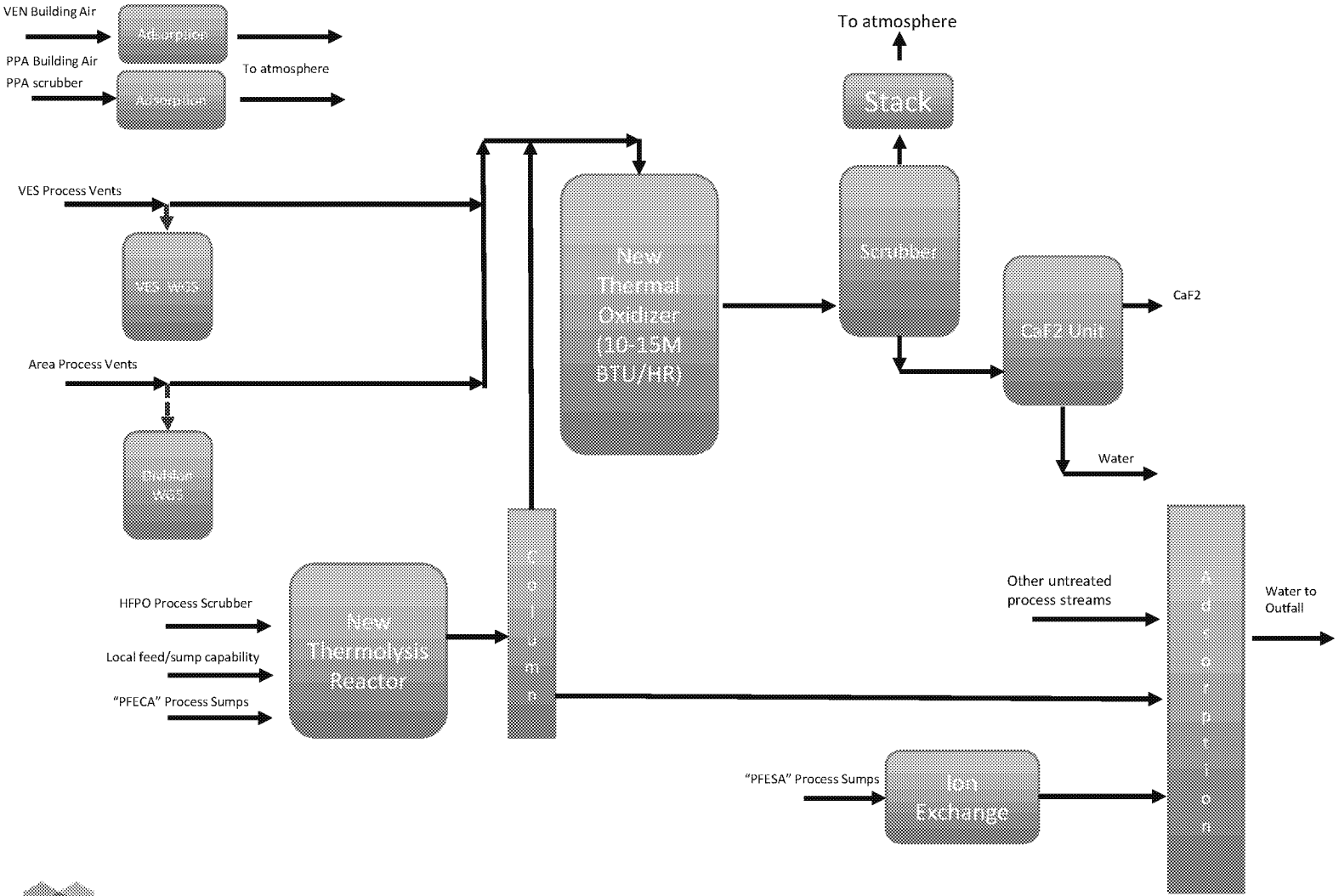
Expected Implementation is end of May 2018.

Expected Improvement: 5-15%.

Technical Elements – Aqueous Emissions Abatement

April 27, 2018

Preliminary Technology Schematic



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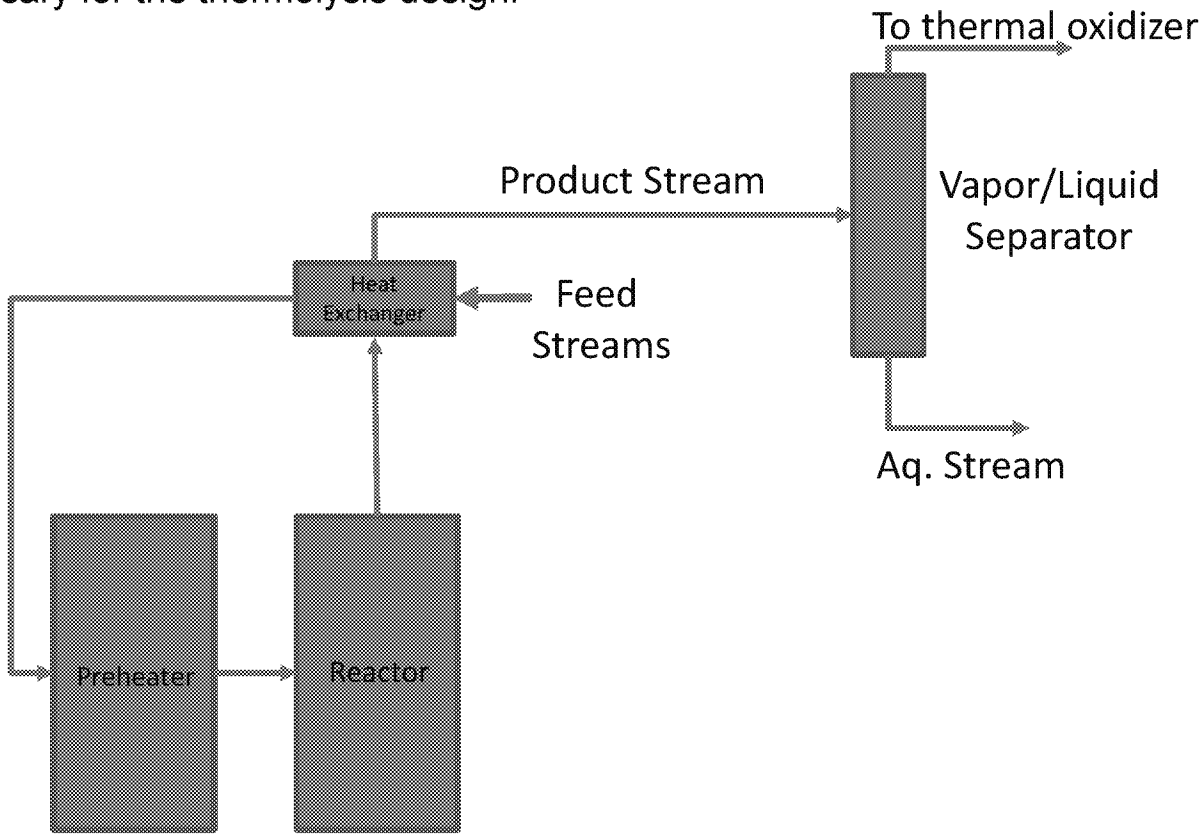
Thermolysis

- Heating PFECA's in water at temperatures of 150°C-250°C results in decarboxylation and/or mineralization.
- Completion of ion exchange and adsorption research will provide remaining details necessary for the thermolysis design.



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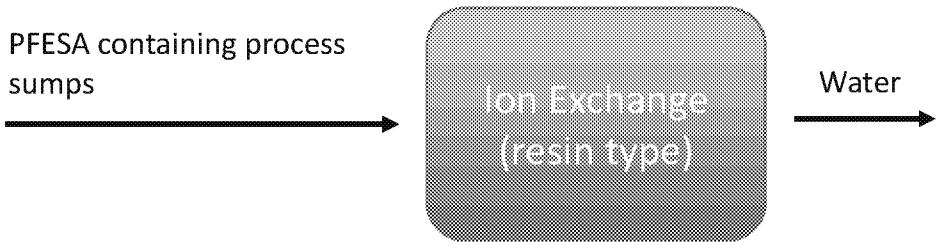
Ion Exchange



- Uses an insoluble anion exchange resin to capture/trap the ionic PFECAs and PFESAs.
- Research to define and quantify effectiveness for PFECAs and PFESAs is in progress.
  - Phase 1 work to testing individual compounds with multiple anion exchange resins is complete pending results.
  - Phase 2 work is testing matrixed solutions.
    - Ready to test the matrixed solution with the PFESAs.

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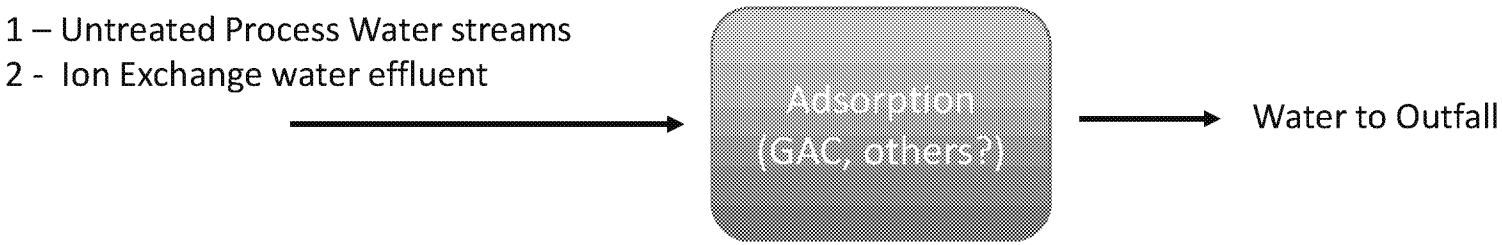
Aqueous Adsorption



- Uses granular activated carbon to remove soluble substances from water.
- Following a similar research protocol as ion exchange
  - Phase 1 work to testing individual compounds is complete pending results.
  - Phase 2 work is testing matrixed solutions.

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